

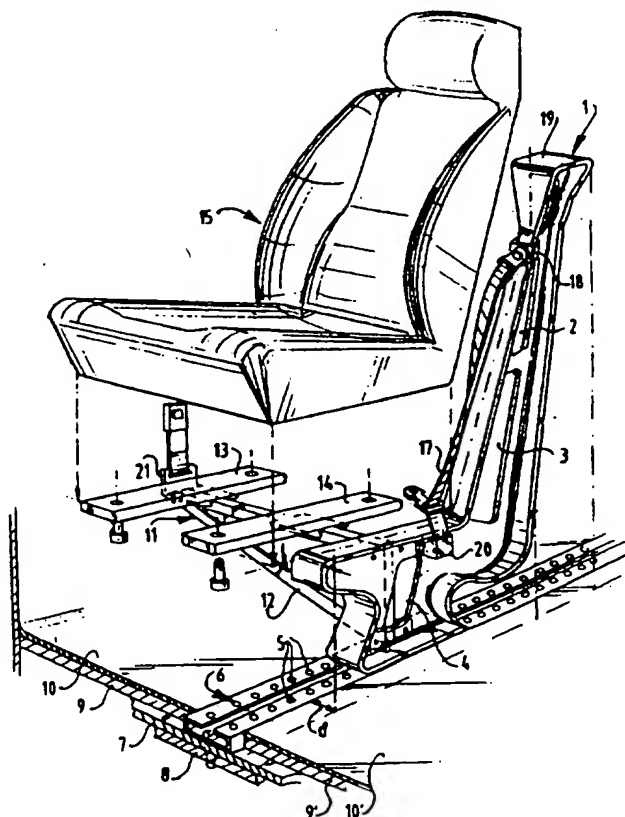


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/NL96/00436 <b>(22) International Filing Date:</b> 7 November 1996 (07.11.96)  <b>(30) Priority Data:</b> 1001595               7 November 1995 (07.11.95)       NL 1003636               18 July 1996 (18.07.96)           NL  <b>(71) Applicant (for all designated States except US):</b> C.A.B.-VOERTUIGTECHNIEK N.V. [NL/NL]; Cartesiusweg 90, NL-3534 BD Utrecht (NL).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> LAMMERTS, Petrus, Hendrikus [NL/NL]; Schimmelpennincklaan 42, NL-3571 BJ Utrecht (NL). DE GROOT, Albertus, Abraham, Petrus [NL/NL]; Rotgans 12, NL-1423 RL Uithoorn (NL).  <b>(74) Agent:</b> LAND, Addick, Adrianus, Gosling; Arnold & Siedsma, Sweelinckplein 1, NL-2517 GK The Hague (NL).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>In English translation (filed in Dutch).</i>

**(54) Title:** SECURING MEANS FOR A VEHICLE SEAT**(57) Abstract**

The invention relates to a member for securing one or two seat elements to the floor of a vehicle, wherein the member is provided with engaging locations for engagement of a safety belt.



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## SECURING MEANS FOR A VEHICLE SEAT

In the past casualties have been caused in accidents with buses because passengers are thrown from their seats. Seats in buses are therefore increasingly being provided with safety belts in order to prevent passengers being thrown from their seats in the case of a collision or when the vehicle rolls over on the longitudinal axis.

More stringent requirements have recently been made known with which seats in for instance vehicles of the M1 category, i.e. with 8 passengers and 1 driver, must comply. Such a seat with safety belt must be able inter alia to withstand a deceleration of 20 g for 0.03 seconds. The securing of the seat to the floor of the vehicle will of course also be an important factor here.

A problem which arises here is that strengthened new seats for each vehicle for the securing to the floor thereof must be tested individually. Present seats are usually geared to comfort and with a marked collision deceleration many known seats as well as the securing of the seats to the vehicle and to the floor consisting of sheet metal are insufficiently strong and rigid to displace the passengers only a little during collision tests.

It is noted that from the international patent application PCT/EP94/01607 a front seat for a motor-home is known which can seat two persons. This is a bench seat which is provided with safety belts and a central column, but on which no seat elements with the requisite comfort can be arranged. The column is herein placed behind the bench seat.

The present invention provides a securing member for securing one or two seat elements to the floor

of a vehicle, wherein the member is provided with engaging locations for engagement of a safety belt.

Because in the case of the securing member according to the present invention all forces are applied hereto, tests with this securing member only have to be carried out for different vehicles, whereafter seat elements of any desired manufacturer can be secured thereon.

The securing member is preferably an aluminium casting with a mass of about 20 kg.

The present invention further provides an assembly of a securing member and a rail which can be anchored to the floor of a vehicle. After testing of the anchoring of the rail in a particular vehicle having the securing member mounted thereon, seat elements of any manufacture can be fixed to the securing member since approval for these types of seat is obtained in all circumstances.

The rail further enables the arrangement of the seat elements in a bus to be changed at regular intervals in accordance with the wishes of the users.

On account of stricter requirements vehicles such as buses for passenger transport must provide seats with safety belts which must be able to withstand an acceleration of 20 g, 6 and 7 g respectively for reinforcing the M2 (carrying capacity greater than 5,000 kg) and M3 (large buses), respectively bus categories for 0.03 seconds.

It is known to arrange rails directly onto a vehicle floor. Seats which are provided with safety belts are secured to these rails.

A problem which occurs here is that the bus floor with the rail attached thereto can buckle under load whereby the seats can for instance be displaced during an accident, which is very dangerous and can result in injuries.

The assembly preferably further comprises a floor construction unit which can be arranged in a

vehicle for securing of one or more seat elements to the floor of the vehicle, which floor construction unit comprises:

- an upper panel,
- 5       - a lower panel, and
- at least one rail between the upper panel and lower panel and connected to both panels, wherein the rail element is provided with at least one securing location for securing a seat element to the floor construction unit and wherein the upper panel is provided with at least one opening corresponding with these securing locations.

Since the seats are arranged on rails which are fixed between an upper and lower panel, i.e. as a kind of sandwich construction, wherein this unit can be arranged integrally in a vehicle, preferably by means of gluing, a floor construction unit is provided which dissipates and absorbs the load forces which occur for instance during accidents, whereby buckling of the bus floor is substantially prevented. In addition, the floor construction unit provides a great bending stiffness.

In order to obtain a good connection between the rails and the respective panels, the rails are preferably glued to the upper and/or lower panels.

25       A strong construction unit is obtained when in preference the rail is extruded integrally.

In preference the rail has in cross section a base which supports on the lower panel, which base is wider than a cross section through the top part of the rail, which top part contacts the upper panel.

During for instance an accident great tensile forces are exerted locally by the seats and the rail, wherein these forces are concentrated on the lower panel. In order to prevent the lower panel from being pulled loose of the rail the wide base of the rail provides a large connecting surface.

At least one support element preferably extends between the base and the top part of the rail. In addi-

tion, the top part of the rail is preferably thickened locally close to the securing locations for the seat elements. This provides a good bending stiffness.

5 In order to give the floor construction unit extra stiffness, filler material is preferably arranged between the upper and lower panel. This filler material must have a great shear strength and stiffness to prevent local buckling and damage of the panels and the rail element and must comply with fire safety requirements.  
10 Suitable filler materials which can be considered are rigid foam (PVC, Rohacell), elements with honeycomb structure (aluminium/Nomex) and balsa wood.

The edges of the floor construction unit are preferably sealed with a seal in order to prevent  
15 degradation of the floor material due to the influence of moisture, heat or other factors.

The present invention further provides a vehicle such as a bus or the like for transporting persons, which vehicle comprises the above stated  
20 assembly.

In a vehicle with an assembly according to the present invention the seats (with securing member) can quickly be removed from the vehicle and fitted therein again. Wheelchairs, drive-on platforms, lifts, luggage  
25 compartments and the like can also be fitted to the floor via the openings therein.

In the further preferred embodiment the openings are keyhole-shaped.

Further advantages, features and details will  
30 be elucidated on the basis of the following description of preferred embodiments thereof with reference to the annexed drawings, in which:

fig. 1 shows a partly exploded view in perspective of a first preferred embodiment of an  
35 application of a securing member according to the present invention; and

fig. 2 shows a partly exploded view in perspective of a second preferred embodiment of a

securing member for two vehicle seats according to the present invention.

Fig. 3a shows a view in perspective of a second preferred embodiment of a securing member according to the present invention with a single side support on the right-hand side;

Fig. 3b shows a view in perspective of securing members of fig. 3a with side supports on both sides;

Fig. 4 shows a view in perspective of an alternative of detail IV of fig. 3b; and

Fig. 5 shows a view in perspective of detail V of fig. 4.

Fig. 6 is a partly cut-away perspective view of the floor construction unit,

Fig. 7 is a side view of the rail of fig. 6, and

Fig. 8 is a side view of a second embodiment of the rail according to the present invention.

A securing support 1 (fig. 1) is a casting preferably manufactured from aluminium which is provided with recesses 2, 3 and 4 therein for further weight-saving. In a manner not shown two or more pins are preferably riveted or otherwise fixed to the underside thereof which can be placed at discrete locations into openings 5 of a rail 6 which is formed by a profile in the form of a reverse  $\Omega$ . Rail 6 is fixed to a floor 7 of the vehicle, preferably with screw bolts to a counter plate 8 which extends for further reinforcement under the floor plate 7 opposite rail 6. Arranged on both sides of rail 6 are further floor plates 9, 9', for instance of wood, to which floor covering 10, 10' is attached, whereby rail 6 is flush-mounted in the floor.

As will be apparent, the securing support can be arranged at different locations along the rail. In a manner not shown locking means can be arranged in the rail, for instance a cam which is rotatable with a ring spanner or the like and which engages on the securing support behind a forward protruding pin, likewise not

visible in fig. 1, and thus locks the securing support in the adjusted position.

On the right-hand side of casting 1 a lateral support construction 11 is fixed thereto, for instance using screw bolts, which comprises a triangular construction 12 to which are fixed girders 13 and 14. A seat 15 of standard manufacture can be mounted on these girders 13, 14. In a manner not shown cross beams are usually situated under the seat part 16 of this seat element, which beams can easily be fastened to the girders 13 and 14. In preference the lateral construction including the girders is likewise formed as one casting.

As indicated with the distance  $d$  in fig. 1, the axis preferably deviates slightly from the vertical, particularly in the lower part of securing support 1, so that when only one seat element is fitted it is unlikely that on the other side a passing passenger will bump against the securing support with his feet.

At a first location 18 close to a top end 19 of the casting a three-point safety belt 17 is fitted thereto in addition to a seat belt roll-up device 20 which is arranged close to the seat part of the seat for securing. The third securing point 21 of the safety belt is situated close to the girder 13 on the triangular lateral support construction 12.

Particularly in the embodiment shown in fig. 2, in which corresponding components are designated as far as possible with the same reference numerals, it can be seen clearly that on the left-hand side of the casting a lateral support construction 11' can likewise be mounted on which girders 13' respectively 14' are arranged so that on both sides seat elements provided with safety belts can be secured via the casting 1 to the floor of the vehicle. In the embodiment of fig. 2 a seat belt roll-up device 30 is fixed to the top end 19 of casting 1, while safety belts 31 respectively 32 extend downward from this seat belt roll-up device 30.



First calculations and tests have indicated that a thickness of the aluminium casting as shown in fig. 1 and 2 of between 50 mm and 100 mm must produce sufficient strength to comply with the more stringent requirements. It is expected that a material thickness close to the back of a seat element will be closer to 100 mm due to the greatest forces which will occur there, while in the lower parts of the casting a wall thickness in the vicinity of 50 mm or more can suffice. The casting is expected to have a weight of 22.5 kg with a weight-saving of 5 kg being gained by the recesses.

A second preferred embodiment of a securing member 30 (fig. 3a, 3b) is manufactured of composite material, i.e. an aluminium casting with plastic therearound. At the sides side supports 31 respectively 32 and 32' are arranged on both sides on which, as in the foregoing figures, seat elements of standard manufacture can be arranged. In fig. 3a is arranged a single lateral support 31 of aluminium tube and plate parts which are welded or glued to each other, while in fig. 3b side frames 32, 32' are arranged on both sides. Fig. 4 shows in more detail an alternative side frame 36, while fig. 5 shows the closing profile 35.

The securing member 30 or console is provided on the underside with so-called quick-closing pins with which the console can be fixed in rapid and simple manner to the floor of a bus. The associated bus floor is preferably embodied as a sandwich panel. The preferred embodiment of the column is constructed round an extruded trapezium-shaped aluminium profile. This profile is preferably provided with an internal ribbing in order to transfer to the floor panel the forces exerted by the side supports and the safety belts not shown in fig. 3-5. Wall thickness increases are applied locally in the extrusion profile to create sufficient material for securing locations provided with screw thread. In these threaded holes are fastened bolts with which the side

supports, belts, quick-closing pins and the locking system are fixed.

5 The cavities in the extrusion profile are filled with foam and a foamed part core is arranged on the top of the extrusion profile. Filling of the extrusion profile with foam and foaming of the upper core can take place in one operation. The assembled core of foam-filled aluminium extrusion profile and foamed part core is then finished in one treatment with a braiding process and carbon fibre is arranged therearound in 10 lengthwise direction and at angles of  $+45^\circ$  relative to the longitudinal axis. The fibres prevent bending of the console, while the fibres at  $\pm 45^\circ$  absorb its load in the case of an eccentric load (embodiment with a single seat part or wherein one passenger is present on the 15 embodiment with two seat elements).

A small quantity of aramid fibre is preferably added during braiding as this has a greater breaking strain than carbon fibre and, in the case the console 20 breaks, prevents a plane of fracture occurring which can cause danger to passengers.

The foamed core with aluminium profile and wrapped with carbon and aramid fibres is then placed in a closed mould into which thermocuring resin (resin 25 transfer moulding RTM) is injected. Because of the foam the resin cannot enter the interior of the aluminium profile.

After curing of the resin the holes required in the console for securing of side supports, belts and the 30 like are drilled and/or provided with screw thread.

The side supports 31, 32 and 33 are frameworks of welded and glued aluminium profiles. The load-bearing part of the side support is assembled from three main profiles 37, 38 and 39 (fig. 4), the axes of which are 35 mutually intersecting in the fastening point of the belt on the closing side. This means that the profiles are oriented such that a rod construction is created in which the profiles are not under strain of bending but only

under strain of tension and pressure. On the console side end surfaces of the profiles are welded to an aluminium plate. This plate is subsequently screwed against the console on the side of the belt fastening point and the profiles are glued in an aluminium casting 35. In the case of a crash the profiles under strain of pressure will press themselves fixedly into the casting. The profile under strain of tension which protrudes in its entirety through the casting is directly loaded by the fastening bolt of the belt secured therein. This has the advantage that the glue connection between the profile and the casting is not heavily loaded. A lighter constructed part of the side supports comprises profiles 40 and 41 on the front side to which a seat element can be secured.

A floor construction unit 101 (fig. 4) has an upper panel 102, a lower panel 104 and a rail 106 arranged between the two panels 102, 104. The floor construction unit is arranged on a bus floor 121.

Rail 106 can be made from an aluminium extrusion alloy such as for instance Al50ST and preferably Al51ST.

Rail 106 (see also fig. 7) is extruded with wider wing parts 108 in order to give rail 106 a broader base. Vertical support elements 110 extend between the base 112 and the top part 114 of rail 106. The top part 114 of rail 106 is provided with a plurality of keyhole-shaped apertures 116 for securing seats to floor construction unit 101. The top part 114 is thickened locally in the vicinity of the securing apertures 116 (see also fig. 7).

An alternative embodiment of the rail (fig. 8) is built up of three separate parts 120, 122, 124 which are glued to each other and also to a main profile 126. This main profile 126 covers the parts 120-124 and extends on both sides in order to give base wing parts 128. Seat element securing apertures 130 extend through both the main profile 126 and the upper part of the

respective parts 120-124. This embodiment of the rail is less expensive to manufacture than the extruded rail 106. In the embodiment of the floor construction unit as shown in fig. 6-8, the rail has two rows of securing apertures 130 but it will be apparent that a single row or a plurality of rows are possible according to the present invention.

The upper and lower panels 102 respectively 104 (fig. 6) are preferably made from a strong aluminium alloy, for instance Al7075, since the tensions in the upper panel can rise during an accident for instance to about 400 MPa.

A filler material 132 is arranged between the upper and lower panels 102 respectively 104. Most preferably this filler material is a rigid foam of 300 kgm<sup>-3</sup>, preferably PVC.

The keyhole-shaped securing apertures 116 in rail 106 and the corresponding openings 117 in upper panel 102 preferably have a diameter of 20 mm and a slot width of 10 mm in which steel closing pins of the securing member are connected to the seat elements (not shown). The screwable connection between securing support and floor is fixed by clamps.

The floor construction unit is assembled by gluing the rail, the floor material and the upper and lower panels. A hot or cold curing epoxy adhesive system can be used for this purpose. An anti-slip and anti-wear layer can further be arranged on upper panel 102 in order to provide a good grip for passengers.

When the floor construction unit is assembled, it is then formed such that it has the correct outer contour depending on the bus floor. Finally, the whole unit is glued to the bus floor.

Due to the ribbed structure of most bus floors only 40 to 50% of the bus floor is suitable as gluing surface. It has been found from research that this is a sufficient gluing surface for a good connecting strength. The mean tensile stresses occurring in this glue layer

are low, with an order of magnitude of 1 to 2 MPa. At the position of the rail the stresses display high peaks due to the local stiffness of the floor construction unit, wherein the maximum value depends inter alia on the geometry and stiffness of the bus floor. A strong and tough elastic glue system is thus recommended for gluing the unit to the bus floor.

Suitable glue systems are acrylate, modified two-component epoxy glues and modified silyl polymers (Simson ISR 70-03, 70-05, 70-08). In order to additionally strengthen the connection to the bus floor, mechanical connections such as bolts can be used between the bus floor and the unit according to the present invention.

The floor construction unit 101 (fig. 6) is manufactured for a bus floor of 3 m x 1.74 m<sup>2</sup>.

This floor construction unit 1 has the following dimensions:

Table 1

**Component**

• panels (3mm)	10 m <sup>2</sup>	at 8.1 kgm <sup>-2</sup>	= 81 kg
• rail (extrusion)	6 m	at 3.5 kgm <sup>-1</sup>	= 21 kg
• filler material (25mm)	4.1m <sup>2</sup>	at 7.5 kgm <sup>-2</sup>	= 31 kg (300 kgm <sup>-3</sup> )
• main profile* (3mm)	6 m	at 2.4 kgm <sup>-1</sup>	= 15 kg
• glue (epoxy)	1 dm	at 1.2 kgdm <sup>-3</sup>	= 1 kg
• Total thickness of the unit	31 mm		
total = 149 kg → 30 kgm <sup>-2</sup>			

(\* main profile optionally integrated in the extrusion profile)

This floor construction unit was subjected to a 20 g static collision test, wherein the following loads were measured for respectively a floor construction unit

with two rows of seats and a floor construction unit with only one row of seats (see table 2, 3 respectively).

Table 2

	F = 65000 N	(Load in forward direction)
5	M = 45 kNm	(Tilting moment)
	T = 0 kNm	(Moment of torsion round top axis)

Table 3

	F = 32500 N	(Load in forward direction)
	M = 22.5 kNm	(Tilting moment)
10	T = 7 kNm	(Moment of torsion round top axis)

The floor construction unit is tested by supporting it hingedly at the front and rear.

The present invention is not limited to the above described preferred embodiments, the requested  
15 rights being defined by the following claims.

## CLAIMS

1. Member for securing one or two seat elements to the floor of a vehicle, wherein the member is provided with engaging locations for engagement of a safety belt.

2. Securing member as claimed in claim 1 which  
5 is cast from aluminium.

3. Assembly of a securing member as claimed in claim 1 or 2 and a rail which can be anchored to the floor of a vehicle.

4. Assembly as claimed in claim 3, provided  
10 with a counter element which can be placed under the floor plate and which serves to strengthen the anchoring.

5. Assembly as claimed in claim 3 or 4, provided with a side support which is fixable to the securing member and on which a seat part of a seat  
15 element is mountable.

6. Assembly as claimed in claim 3, 4 or 5, provided with a three-point safety belt, wherein a first engaging location thereof is situated close to a top end of the securing member at the height of the shoulder of a  
20 passenger in a seat element, a second securing location is situated on the securing member at the height of the seat part of the seat element and a third engaging location is situated on the side support.

7. Assembly as claimed in any of the claims 3-  
25 6, provided with adjusting means for adjusting the securing member along the rail.

8. Assembly as claimed in claim 7, provided with locking means for locking the securing member in the set position.

9. Assembly as claimed in one or more of the  
30 claims 3-7, wherein the rail forms part of a floor construction unit comprising an upper panel and a lower panel, wherein the rail is arranged between the upper

panel and lower panel and is connected to both panels,  
wherein the rail is provided with at least one securing  
location for securing a seat element to the floor  
construction unit and wherein the upper panel is provided  
5 with at least one aperture corresponding with these  
securing locations.

10. Assembly as claimed in claim 9, wherein the  
rail is glued to the upper panel and/or lower panel.

11. Assembly as claimed in claim 9 or 10,  
10 wherein the rail is extruded integrally.

12. Assembly as claimed in claim 9 or 10,  
wherein the rail is built up of two or more rail  
profiles.

13. Assembly as claimed in any of the foregoing  
15 claims, wherein the rail has in cross section a base  
which supports on the lower panel, which base is wider  
than a cross section through the top part of the rail,  
which top part contacts the upper panel.

14. Assembly as claimed in any of the foregoing  
20 claims, wherein at least one support element extends  
between the base and the top part of the rail.

15. Assembly as claimed in any of the foregoing  
claims, wherein the top part of the rail is thickened  
locally close to the securing locations.

25 16. Floor construction unit as described in the  
claims 9-15.

17. Member as claimed in claim 1, provided with  
fastening means arranged on either side for fastening one  
or two side frames on one or two sides.

30 18. Member as claimed in claim 1, 2 or 17,  
provided with plastic on the aluminium.

19. Member as claimed in claim 8, wherein foam  
plastic is arranged in the interior of the casting.

35 20. Assembly as claimed in any of the claims  
9-15, wherein apertures in the floor are keyhole-shaped.







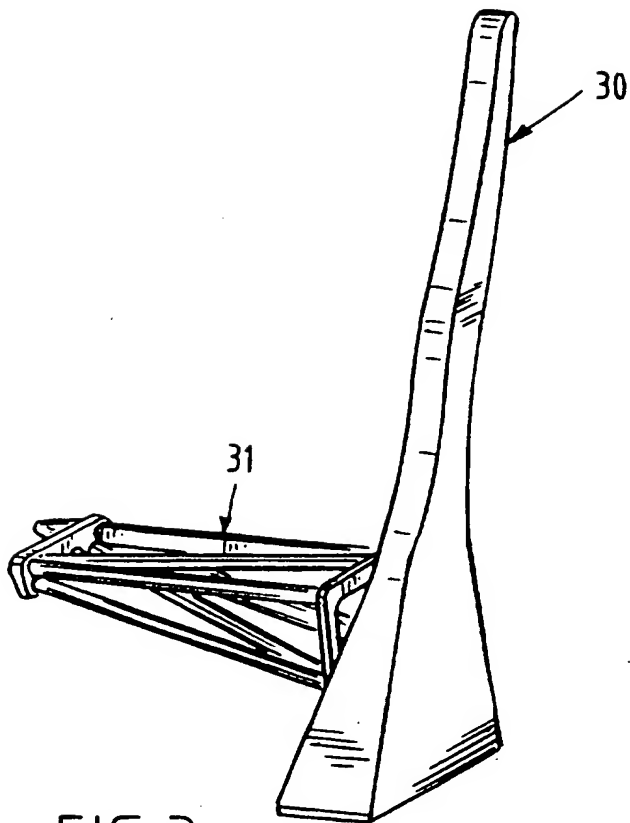


FIG. 3a

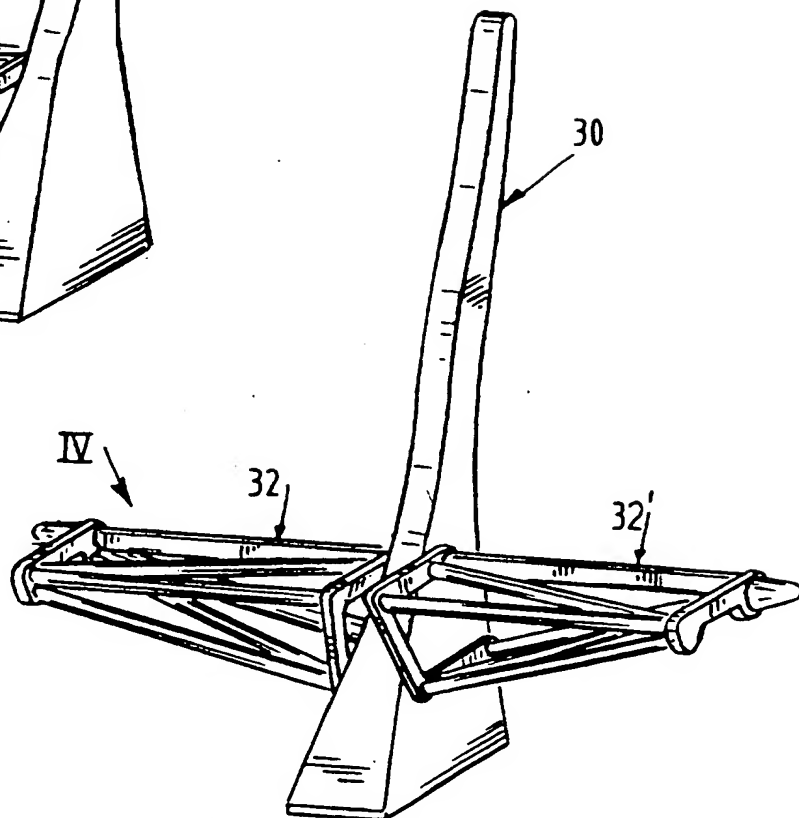


FIG. 3b

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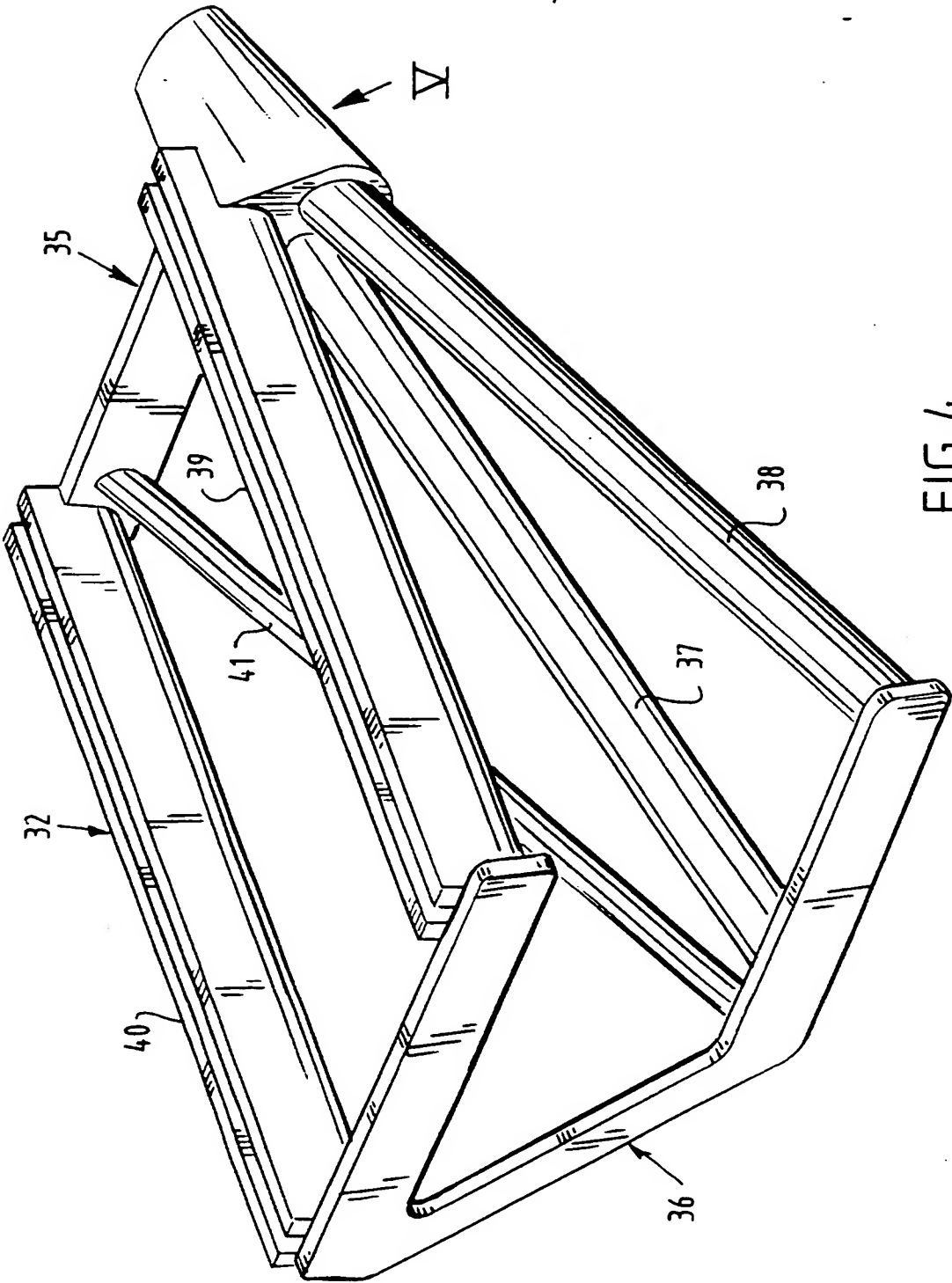
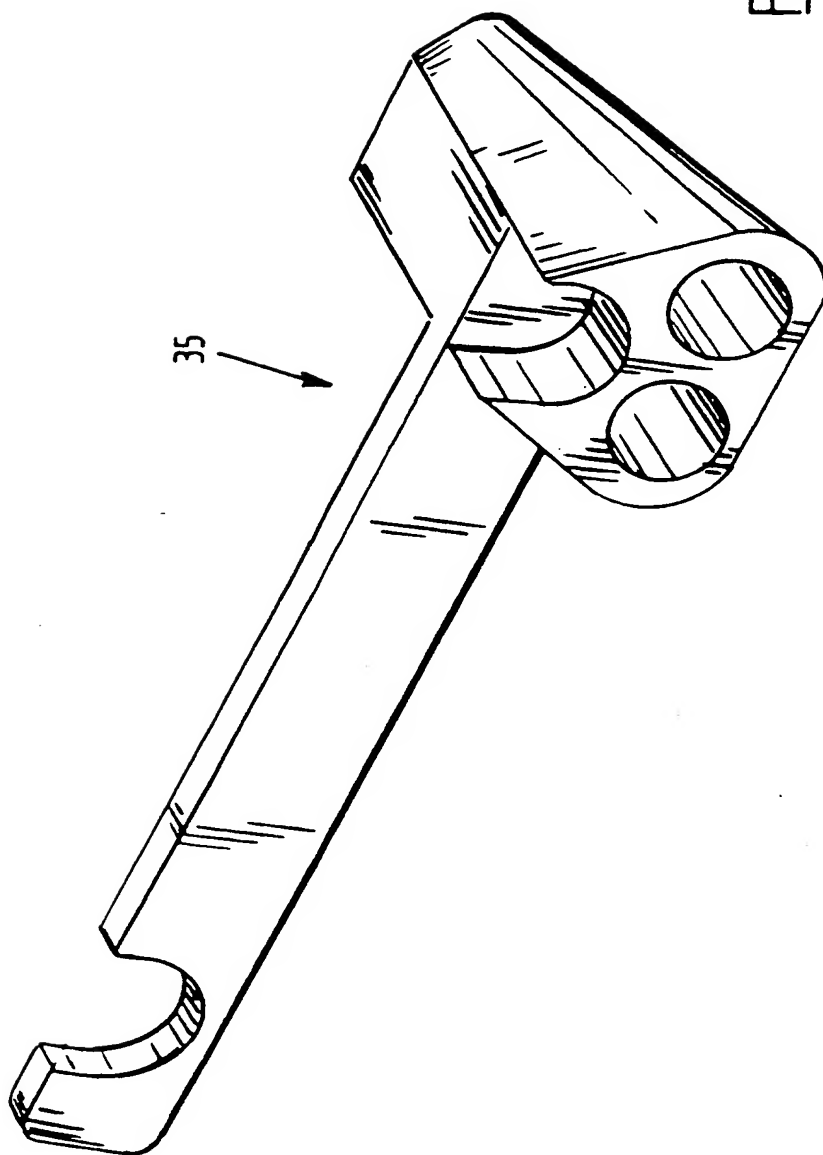


FIG. 4

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FIG. 5



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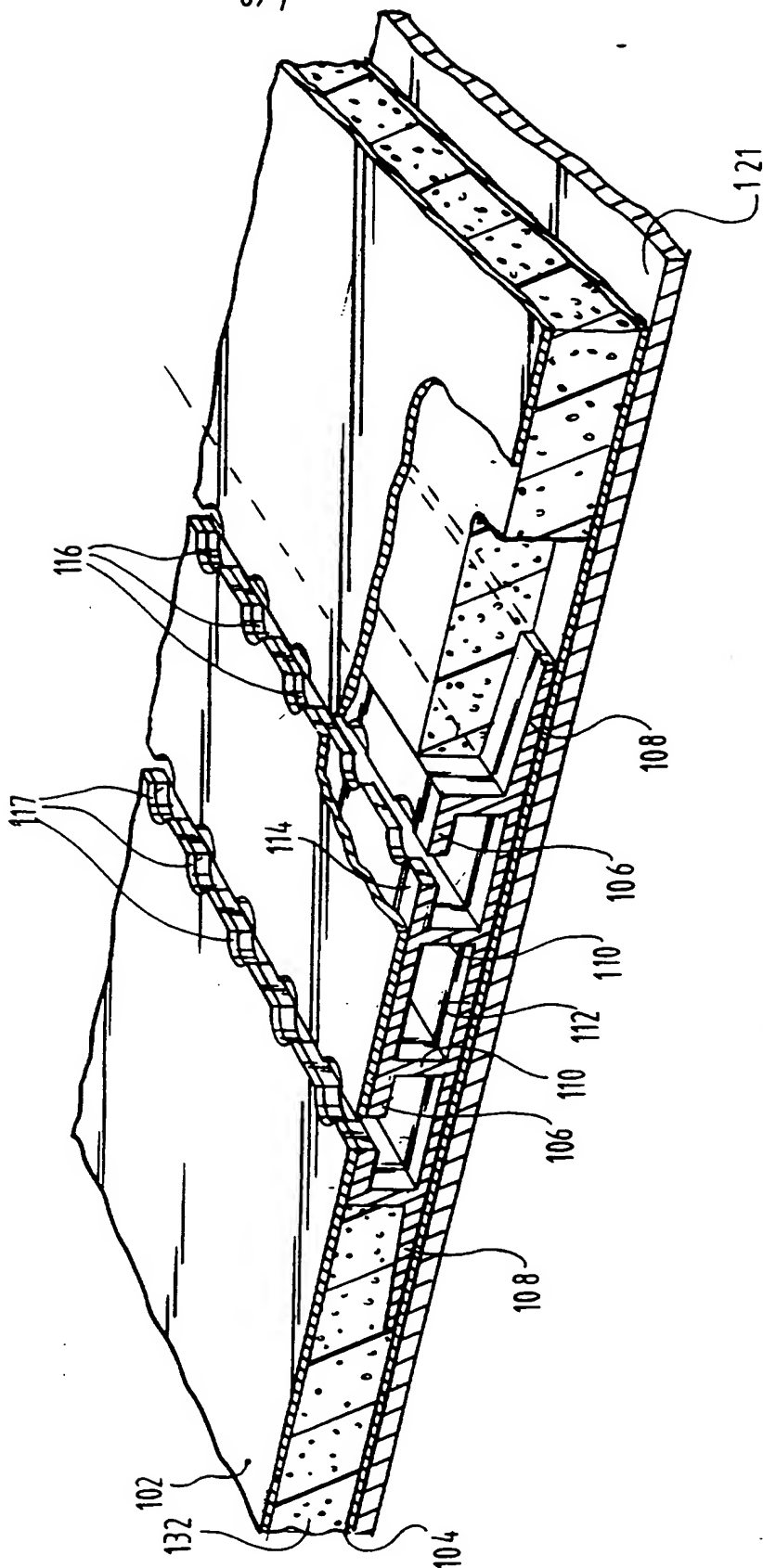


FIG. 6

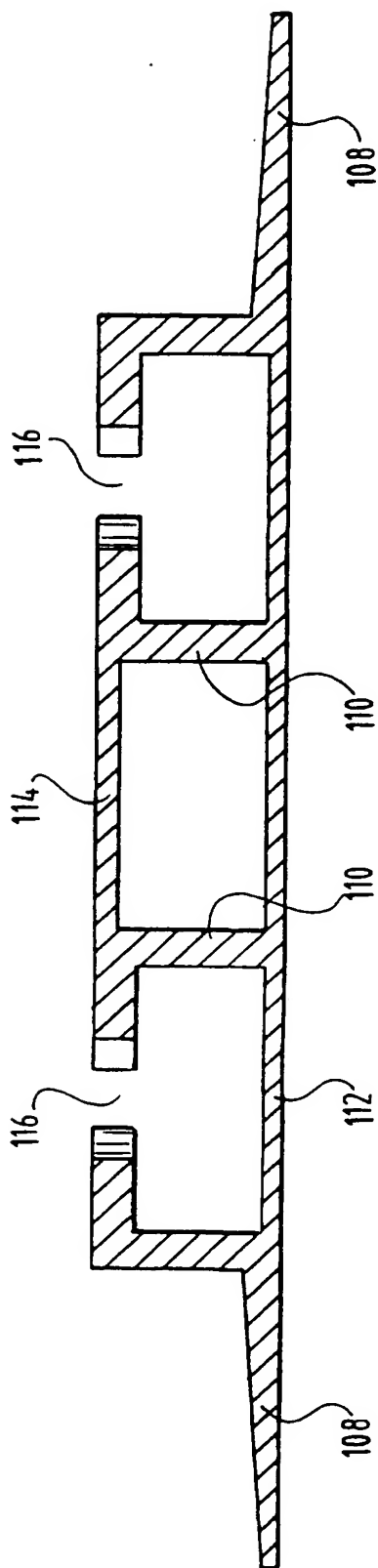


FIG. 7

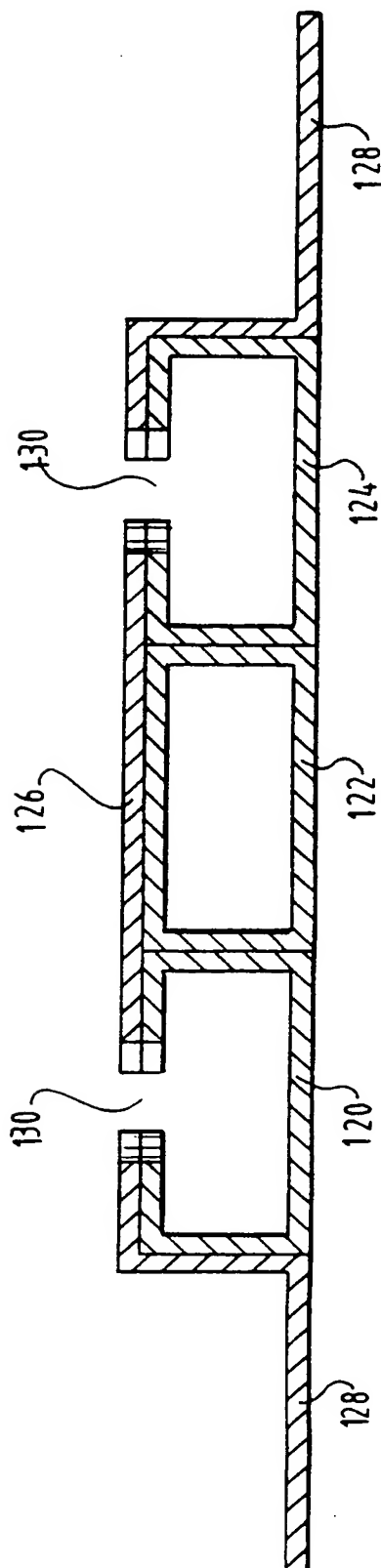


FIG. 8

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/NL 96/00436

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 B60N2/24

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 B60N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94 26553 A (AGUTI SITZTECHNIK GMBH ;GRIEGER ANDREAS (DE)) 24 November 1994 cited in the application	1,3
A	see page 5, line 23 - page 7, line 13; figures 1-6	16
A	--- EP 0 628 468 A (ALUSUISSE LONZA SERVICES AG) 14 December 1994 see column 7, line 21 - column 9, line 11; figures 1-8	1,2
A	--- US RE30871 E (ARTHUR J. HARDER, JR.) 23 February 1982	
A	--- EP 0 053 012 A (UOP INC) 2 June 1982	
A	--- EP 0 330 594 A (SABLE SA) 30 August 1989	
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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17/02/97

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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